SECTION IV.—RIVERS AND FLOODS.

RIVERS AND FLOODS, JULY, 1915.

By ALFRED J. HENRY, Professor of Meteorology, in Charge of River and Flood Division.

[Dated Washington, D. C., Aug. 28, 1915.]

There were no severe floods in the great rivers of the United States, and none of the spectacular events that are associated with severe floods in large rivers, yet the total flood loss during the month, if it were possible to compute it accurately, would be startling. The great bulk of the loss fell upon agricultural interests.

The precipitation of the month was remarkably heavy within a radius of, say 100 miles from Kansas City Mo.; also over a comparatively small area in northwestern Ohio and a larger area in New England; stretching thence to the southwest over the headwaters of the North Branch of the Susquehanna. These areas may be considered as so many islands of higher precipitation in a general belt of heavy rainfall that extended from central New England westward, just south of the Lower Lakes, and over northern Ohio, northern Illinois, northern Missouri, to the region of maximum precipitation for the month. See Chart No. V, this REVIEW. This distribution of precipitation did not parallel any of the larger river systems, but it was of sufficient magnitude to embrace practically the entire watershed of many of the small streams and rivers, particularly in northwestern Missouri, southwestern Iowa and northern Ohio.

Floods in Missouri.—The heavy rains of May and June in northeast Kansas and northwest Missouri continued during July. Some of the greatest monthly amounts are given below:

	inches.
Maryville, Mo.	20.22
St. Joseph, Mo.	12.97
Manhattan, Kans.	12.38
Wamego, Kans.	10.33
Blue Rapids, Kans.	9.46
Beatrice, Nebr.	8.83
Hanover, Kans.	8.65
Clay Center, Kans.	7.85
Horton, Kans.	7.09

As a result of these heavy monthly rains the great bulk of the run-off was concentrated in the Missouri River, in the vicinity of Kansas City. The Kansas River was in flood in its lower stretches, as at Topeka, on but two days, the 17th and 18th, with a crest scarcely 1 foot above flood stage. The river, however, carried a large volume of water during the entire month, and was thus influential in keeping the Missouri at a high stage. The last named, above Kansas City, was also near bankfull stage on several days, and on the average carried a larger volume of water than usual. Thus it happened that the run-off from the heavy rains at the place above named was sufficient to cause the Missouri River at Kansas City to exceed the flood stage on 19 of the 31 days, as shown in the table below. Below Kansas City there were one major and two minor flood waves. The first, a minor wave, passed from Kansas City to Waverly, Mo., from the 1st to the 4th. Below Waverly it flattened out to slightly below bankfull stage. The second and principal flood of the month began at Kansas City on the 14th and continued until the 28th. This wave had not yet passed into the Mississippi at the close of the month. The second minor wave began at Kansas City on the 29th and had reached Boonville, Mo., at the end of the month. It was in progress down the river at the close of the month.

The details of the Missouri floods are shown in the table below:

Missouri River floods, July, 1915.

Stations.	Flood stage.	Above flood stage.		Crest.	
		From—	To—	Stage.	Date.
	Feet.			*Feet.*	
Townsend, Mont.	6.8	13	13	6.8	13
Do.	6.8	17	17	6.8	17
Running Water, S. Dak.	16.0	16	16	16.4	16
Blair, Nebr.	15.0	23	23	15.1	23
St. Joseph, Mo.	12.0	21	21	12.2	21
Kansas City, Mo.	22.0	1	3	23.9	2
Do.	22.0	14	28	[1] 29.0	21
Do.	22.0	29	31	25.0	31
Waverly, Mo.	22.0	3	3	22.0	3
Do.	22.0	14	28	25.9	22
Do.	22.0	31	31	22.7	31
Boonville, Mo.	21.0	16	30	25.0	20
Do.	21.0	31	31	21.1	31
Hermann, Mo.	21.0	18	29	24.3	21

[1] The crest stage of this flood at Kansas City was the highest July stage ever recorded at that place.

Floods in Mississippi River.—Two small flood waves were observed in the Mississippi during the month. The first passed Cape Girardeau, Mo., on the 1st, when the river was 3 feet above flood stage. This swell did not reach a flood stage at points between Cape Girardeau and Arkansas City, Ark. At the last named the crest of the wave was 1.8 feet above flood stage, and the river remained above flood stage from the 1st to the 13th. Below Arkansas City the swell flattened out.

The second wave was of about a week duration at St. Louis, Mo. It was preceded by several minor swells of short duration. The details may be seen in the subjoined table.

July floods in Mississippi River.

Stations.	Flood stage.	Above flood stage.		Crest.	
		From—	To—	Stage.	Date.
	Feet.			*Feet.*	
Quincy, Ill.	14.0	31	31	14.1	31
Hannibal, Mo.	13.0	26	26	13.0	26
Do.	13.0	30	31	14.2	31
Grafton, Ill.	18.0	15	16	18.1	16
Do.	18.0	22	24	18.2	23
Do.	18.0	27	28	18.0	28
St. Louis, Mo.	30.0	21	28	31.3	23
Cape Girardeau, Mo.	30.0	19	31	31.8	25
Do.	30.0	1	1	33.0	1
Arkansas City, Ark.	42.0	1	13	43.8	6

The Grand River of Missouri.—The Grand River was in the belt of almost continuous rains. At Chillicothe it passed above flood stage, 18 feet, on the 12th, crested at 29.7 feet on the 17th, and passed below the flood stage on the 29th.

Illinois River.—The upper Illinois River was in flood from the 13th to the 22d, inclusive, and in its lower reaches, as at Beardstown, from the 12th continuously until the end of the month.

Freshets in north-central Ohio.—Rainfalls during the first decade of July, followed by excessive precipitation on the 15th and 16th—from 4 to 5½ inches being recorded at stations in Harden, Allen, and Marion Counties—caused sharp rises in the upper branches of the Scioto and Sandusky Rivers and the Walhonding and other branches of the Muskingum. Much lowland property was overflowed; losses of stacked hay, grain, and growing crops exceeded in some localities the damage to farming interests caused by the spring flood of 1913. Loss due to destruction of crops in Harden County alone (mainly onions and sweet corn) is conservatively estimated at $2,000,000. Otherwise the damage to property interests, permanent works, etc., was comparatively unimportant. A table of crest stages at the several points affected is given below.

Crest stages in Ohio rivers, July, 1915.

Rivers and stations.	Flood stage.	Crest.	
		Stage.	Date.
Walhonding River:	*Feet.*	*Feet.*	
Walhonding, Ohio	8.0	12.6	16
Tuscarawas River:			
Coshocton, Ohio	8.0	9.1	17
St. Joseph River:			
Montpelier, Ohio	10.0	9.6	8
Olentangy River:			
Delaware, Ohio	9.0	13.2	16
Scioto River:			
Prospect, Ohio	10.0	14.9	18
Bellpoint, Ohio	9.0	10.8	16
Columbus, Ohio	17.0	18.1	17
Chillicothe, Ohio	14.5	15.5	19

Indiana.—Severe thunderstorms during July 8–9 brought heavy rains over the watershed of the upper Wabash River and tributaries, resulting in moderate flood stages and damage to lowland farming interests. As the water receded rapidly, a total loss of crops was suffered in but few localities. A table of crest stages in the Wabash and the White Rivers follows:

Crest stages in the Wabash and White Rivers, Indiana, July, 1915.

Rivers and stations.	Flood state.	Crest stages.	
		Crest.	Date.
Wabash River:	*Feet.*	*Feet.*	
La Fayette, Ind.	11.0	14.5	17
Terre Haute, Ind.	16.0	14.8	9
White, West Fork:			
Elliston, Ind.	19.0	23.1	12
White River:			
Decker, Ind.	18.0	18.2	16

Floods in North Branch of Susquehanna.—Heavy rains, July 8–9, caused severe local freshets and washouts in the upper tributaries and moderate flood stages south to Wilkes-Barre, Pa. Damage to crops, highways, bridges, and railway embankments has been variously estimated at from $300,000 to $600,000. All crops in bottom lands of the upper tributaries were under water from 5 to 12 days and will be a total loss.

Crest stages in the Unadilla and the Susquehanna (North Branch), July, 1915.

Rivers and stations.	Flood stage.	Crest stage.	
		Stage.	Date.
Unadilla River:	*Feet.*	*Feet.*	
New Berlin, N. Y.	9.0	9.9	9
Susquehanna, North Branch:			
Oneonta, N. Y.	10.0	15.4	9
Binghamton, N. Y.	14.0	15.2	9
Towanda, Pa.	16.0	17.5	9
Wilkes-Barre, Pa.	20.0	22.3	10
Harrisburg, Pa.	17.0	11.3	10

Red River and tributaries.—The Red River has been in frequent flood during the current season. Much loss has been sustained, due to the overflow of bottom lands. Moderate to heavy rains during the first week of the month caused flood stages to be reached and passed, as shown in the small table below:

Crest stages in the Red and Sulphur Rivers, July, 1915.

Rivers and stations.	Flood stage.	Above flood stage.		Crest stage.	Date.
		Fro—	To—		
Sulphur River:	*Feet.*			*Feet.*	
Finley, Tex.	24.0	4	10	27.4	5
Red River:					
Fulton, Ark.	28.0	6	9	28.6	7
Springbank, Ark.	29.0	11	12	29.3	11

SCATTERED FRESHETS.

The heavy rains of the 8th and 9th resulted in bankful stages at points on the Connecticut, Hudson, and Delaware Rivers. Highways were gullied and traffic delayed generally over a portion of Pennsylvania, New York, and the New England States. A table of crest stages at those stations which reached or exceeded flood stage is given below.

Crest stages in the Delaware, Hudson, and Connecticut, July, 1915.

Rivers and stations.	Flood stage.	Crest stage.	
		Crest	Date.
Delaware, East Branch:	*Feet.*	*Feet.*	
Fishs Eddy, N. Y.	10.0	10.4	9
Delaware, West Branch:			
Hale Eddy, N. Y.	12.0	11.9	9
Hudson River:			
Troy, N. Y.	14.0	15.7	11
Connecticut River:			
White River Junction, Vt.	13.0	12.9	10
Hartford, Conn.	16.0	16.4	10

Rio Grande River.—Exceptionally high water for July prevailed during the entire month at El Paso, Tex.; the river being above flood stage, 15 feet, from the 1st to the 4th, inclusive, and again on the 28th, 29th, and 31st. Heavy local rains in the vicinity of San Marcial, N. Mex., caused material damage to bridges, highways, railroad property, and growing crops.

Hydrographs for typical points on several principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and

Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.

MEAN LAKE LEVELS DURING JULY, 1915.

By UNITED STATES LAKE SURVEY.

[Dated: Detroit, Mich., Aug. 5, 1915.]

The following data are reported in the Notice to Mariners of the above date:

Data.	Lakes.			
	Superior.	Michigan and Huron.	Erie.	Ontario.
Mean level during July, 1915:	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Above mean sea level at New York	602.29	579.92	572.08	245.13
Above or below—				
Mean stage of June, 1915	+0.34	+0.14	+0.22	+0.01
Mean stage of July, 1914	−0.39	−0.80	−0.74	−1.59
Average stage for July, last 10 years	−0.19	−1.12	−0.76	−1.83
Highest recorded July stage	−1.53	−3.66	−2.33	−3.59
Lowest recorded July stage	+0.81	+0.02	+0.62	+0.54
Probable change during August, 1915	+0.2	0.0	−0.2	−0.3